COMPUTATIONAL MECHANICS

Bert Sluys
Chair Computational Mechanics

Applied Mechanics section
Department Materials, Mechanics, Management & Design (3MD)
Faculty of Civil Engineering and Geosciences, TU Delft
Mainly within Structural Mechanics specialization:

- Dynamics courses
- Structural element courses (beams, plates, shells)
- Computational mechanics courses

Preferred sequence for computational mechanics "package":

- Analysis of slender structures (CIE4190, Q1, 4 ECTS)
- Introduction to the Finite Element Method (CIE5123, Q3, 4 ECTS)
- Computational methods in nonlinear solid mechanics (CIE5142, Q4, 3 ECTS)
- Computational modelling of structures (CIE5148, Q1/Q5, 4 ECTS)
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Introduction to the Finite Element Method (CIE5123)

We will teach you:
• background mathematics/mechanics
• FEM solution procedures
• simple FEM programming, insight in structure FEM code
• modelling with FEM
• how to interpret FEM results
Computational methods in nonlinear solid mechanics (CIE5142)

We will teach you:

• difference in material and geometrical nonlinearities
• nonlinear solution techniques (Newton-Raphson procedures)
• nonlinear constitutive modelling (plasticity, damage, fracture)
• simple nonlinear FEM programming, structure of nonlinear FEM code
• issues as bifucation, stability, convergence, mesh sensitivity etc.
Computational methods in nonlinear solid mechanics (CIE5142)

• Novel/robust FE-techniques (XFEM) for *arbitrary* crack propagation (left)
  and *multiple/competing* fracture mechanisms in composites (right)
Recent MSc-projects in Computational Mechanics group:

- Numerical modelling of cone cracking in ceramics via indentation
- The Virtual Element Method - Applications to linear and gradient elasticity
- FE analysis to assess the protective capabilities of helmets against blast loads
- FE and BE modelling of geothermal structures
- FE modelling of fiber reinforced composites
- Numerical framework for ageing and fatigue in laminated composites
Ongoing challenging MSc-project(s) on metamaterials

- So-called auxetic material with a negative Poisson’s ratio
- Materials demonstrate increased indentation resistance and shear stiffness
- Beautiful!! But, what about strength and durability properties....
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Ongoing challenging MSc-project(s) on geothermal energy/energy piles

- Provide geothermal heating to buildings
- FEM/BEM modelling of mechanical behaviour and heat flow in shallow geothermal systems
- Optimize geothermal systems w.r.t. efficiency (reduce energy loss)